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BRIEF NOTE

ECOLOGY OF A FALL POPULATION OF THE CLAM SHRIMP *CAENESTHERIELLA GYNECIA* MATTOX (CRUSTACEA: CONCHOSTRACA)[1]

KENNETH C. EMBERTON, JR.,[2] Department of Zoology and Microbiology, Ohio University, Athens, OH 45701

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Mattox (1950) described the conchostracan *Caenestheriella gynecia* found in small, shallow, mudbottom temporary pools at Oxford, Ohio. Experimental data have been reported on the conditions for egg development and hatching of *C. gynecia* as well as field data on spring and summer, but not fall populations (Mattox and Velardo 1950). The purpose of my study was to monitor a late-season (fall) population of *C. gynecia* (fig. 1) to determine behavior, density and distribution, sex ratio, presence and distribution of egg masses, and growth rate. A population of *C. gynecia* was located in Zaleski State Forest, Vinton County, Ohio, in a 3.3 m² puddle formed by tire tracks in a logging road. I visited the population on 4 occasions in 1978: late August, 15 September, 7 October, and 28 October.

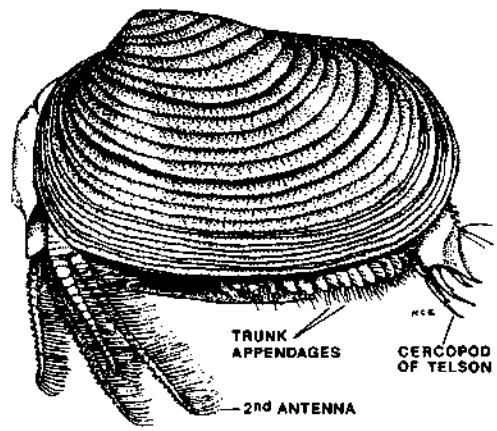

FIGURE 1. *Caenestheriella gynecia:* an adult female from the study population. Shell length is 11.7 mm.

Behavior: When the conchostracans were first observed in late August, all appeared to be actively swimming. Regular beats of the second antennae propelled them in an apparently random fashion and the body assumed no particular

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[2]Present address: Committee on Evolutionary Biology, University of Chicago, Chicago, Illinois 60637.

orientation. On all 3 subsequent field observations, however, all individuals (unless disturbed) were half buried in mud, ventral side up, with rhythmic waves of the trunk appendages passing from head to tail. No distinct burrowing behavior was observed; positioning in the mud appeared to be achieved by a random process. This buried position suggested filter feeding activity. Since burying seems to occur only late in the season, it could serve some further function, perhaps that of placing eggs (within the newly-molted shell) in the mud where they would be less likely to dry out. Unlike most arthropods of temporary pools, *C. gynecia* lays eggs whose development and hatching are inhibited by drying (Mattox and Velardo 1950).

While attempts were being made to photograph live specimens held in wax or folded paper, these specimens made strong swimming movements and infrequently convulsed, *i.e.* dorsally flexed the second antennae, telson, and entire body while maximally gaping the shell. Such an effort often quickly freed the prisoner, indicating that the conchostracans were probably capable of extricating themselves from the mud in their native habitat.

Distribution and Density: On 15 September, 2 transects were made of the study puddle. One transect consisted of 5 stations placed every 0.5 m along a single tire track from shallowest (1.5 cm) to deepest (5.1 cm). The other transect of 5 pairs of stations placed every 0.3 m across the greatest width of the puddle ran from low grass on one side to tall overhanging grass on the other side. At each of the 15 stations, a gallon plastic milk container with the bottom and top sliced off (leaving the handle) was jammed into the mud to enclose an area of 220 cm^2. Water depth was measured at the center of the contained area with a plastic rule. The rule was then struck once with a stick in a rehearsed and consistent manner to get an estimation of the depth and softness of the mud bottom. All conchostracans in the contained area were captured by hand and by straining the roiled water through a brass sieve of 0.5 cm mesh.

The number of conchostracans per 220 cm^2 sample ranged from 0 to 7, with highest densities toward the center of the puddle, away from overhanging grass. Avoidance of overhanging grass would have obvious antipredatory advantages (*e.g.*, large dytiscid beetles were found to favor those haunts) and would be facilitated by positive phototaxis. Strong positive phototaxism has been demonstrated for all early stages of the conchostracan *Eulimnadia texana* (Strenth and Sissom 1975), and presumably it occurs in *C. gynecia* as well. The importance of light to *C. gynecia* is suggested by its prominant frontal eyespot.

The correlation of conchostracan density with water depth and with mud depth was calculated using Kendall's tau. This and other statistical tests followed methods given in Sokal and Rohlf (1969). No significant correlation was found between density and water depth or mud depth.

On 7 October, dispersion of conchostracans within the study puddle was determined by the nearest neighbor method (Poole 1974), which necessitated counting all individuals. Disperson was highly aggregated ($P<0.001$). Aggregations tended to occur in slight depressions within the mud bottom and therefore may have been mechanical rather than social in origin.

On 15 September the estimated total population was 219 ($67/m^2$), which may be an overestimate due to nonrandom sampling. On 7 October the total count was 74. Taking into account that 22 were removed on 15 September and assuming that they would have suffered the same mortality rate, the total population estimate was 82 ($26/m^2$). For 28 October, when all remaining conchostracans were captured by repeated netting, the total population estimate was 37 ($12/m^2$). Based on these data, it was calculated that the conchostracan population decreased by 62% between 15 September and 7 October and by another 54% between 7 October and 28 October, with only 17% surviving the 6-week period which included the first frost of the season. Deteriorating weather conditions presumably were responsible for this rapid die-off.

Sex Ratio: Specimens from all 4 col-

lections (total 92) were sexed. Females were recognized by the absence of special clasping modifications of the first and second trunk appendages (Mattox 1959). All 92 *C. gynecia* collected were females. If any males had been present in the population, it can be stated with 95% confidence (based on iterative chi-square analysis) that they could not have constituted more than 4.1%. If indeed there had been males at such low densities, they probably would have been conspicuous as they swam about to fertilize more than one female. Since no such activity was observed, I assume that the population was entirely female.

Mattox (1950) reported that "several hundred specimens of *C. gynecia* have been collected from nature, and raised in the laboratory, over a period of the past seven years and all have been females." Indeed, it was for that reason he named the species *gynecia*. Paul and Nayar (1977) cited *C. gynecia* as one of only 3 species of conchostracans in the world for which males were "not yet known." Sissom (1967, cited in Strenth and Sissom 1975), studying the conchostracan genus *Eulimnadia*, reported that some populations averaged 25% males and others had only females. Belk (1972) found both sexual and asexual reproduction in *Eulimnadia autlei*. All other American species of the genus *Caenestheriella* have males (Mattox 1950). On the basis of this evidence, I predict that males of *Caenestheriella gynecia* will one day be found. It would be of great interest to know if, when, and how males do occur in populations of this and other species of conchostracans.

Egg Bearing: Each female from the last 3 collections (n=73) was examined for the presence or absence of egg masses, which are carried between the body and the dorsal part of the shell. Shell length was measured. In both the 15 September and 28 October collections, 50% of the conchostracans were ovigerous, but on 7 October 60% were ovigerous. This difference was significant (G-test for independence, $P<0.001$) and was probably due to temporary increase in temperature and/or rainfall (Mattox and Velardo 1950). In the collection of 7 October, but not in the other 2 collections, more small females were ovigerous than large females ($P<0.05$). Range in shell length for the test was 10.8 to 12.6 mm.

Mattox (1950) found ovigerous *C. gynecia* as short as 7 mm, which suggests that all individuals in my collections were of egg-bearing size (total range in shell length for the 3 collections was 9.7 to 12.6 mm). Egg production was continuous for *Eulimnadia texana* (Strenth and Sisson 1975), and was so implied for spring and summer populations of *C. gynecia* (Mattox 1950). In this fall population, despite rapid die-off (83% mortality in 6 weeks), *C. gynecia* continued to produce eggs.

Growth Rate: Mean shell length increased at a steady rate from 11.16 mm on 15 September to 11.25 on 7 October to 11.40 on 28 October. Means were based on 22, 25, and 26 specimens, respectively. Large intrapopulational variance resulted, however, in an insignificant difference among dates (ANOVA, $0.10<P<0.25$).

Some conchostracan species can complete a life cycle (egg to egg-bearing) in as little as 7 days (Strenth and Sissom 1975). *C. gynecia* in laboratory cultures has a life cycle as brief as 23 days (Mattox and Velardo 1950), growing from <1 to 11 mm in that time. The fall population I observed grew much slower, as evidenced by the more closely spaced growth lines on the most recently accumulated shell of a typical specimen (fig. 1). Decreased growth rate was probably attributable to low temperatures and to channeling of metabolic energy into egg production. If this is true, then fossil conchostracans may be of high value not only as indicators of geologic facies (Tasch 1973), but also as keys to reconstructing paleo-climates.

Killing and Preservation: A number of methods for fixation were tried (formalin, ethanol, freezing followed by formalin, Neosynephrine followed by formalin, magnesium chloride solution followed by formalin, and chloral hydrate solution followed by formalin). Overnight treatment with chloral hydrate (about 3 medium-sized crystals/20 ml tapwater) was the only method resulting in well-extended kills for preservation. The conchostracans were remarkably

hardy. For example, several were frozen in cubes of ice, and the cubes were added to an equal volume of 40% formalin. As the ice melted, the conchostracans swam about for several minutes before succumbing with closed shells.

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